

Nov. 30, 1965

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3,220,408

FACE MASKS

Filed June 14, 1962

2 Sheets-Sheet 1

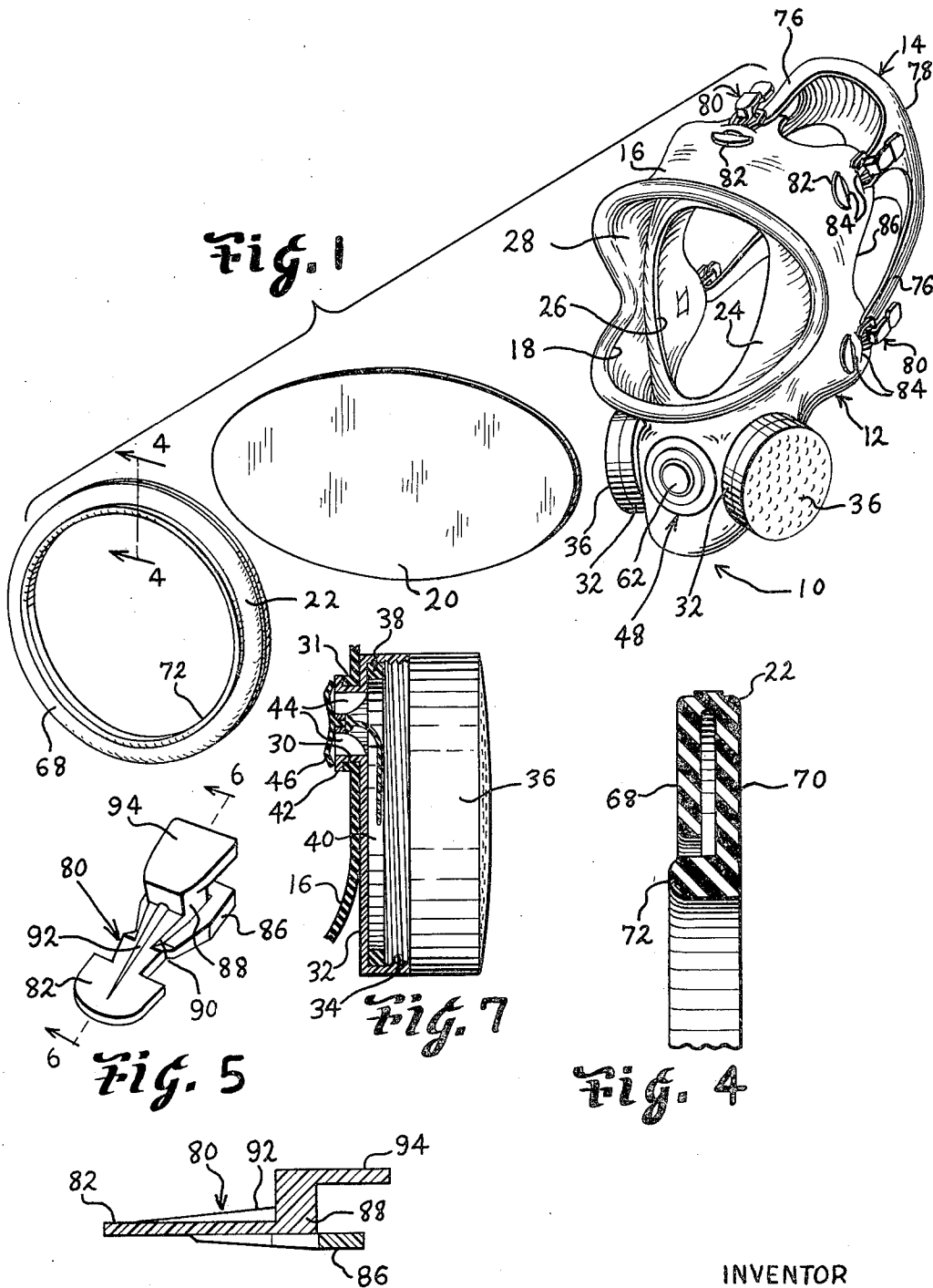


Fig. 6

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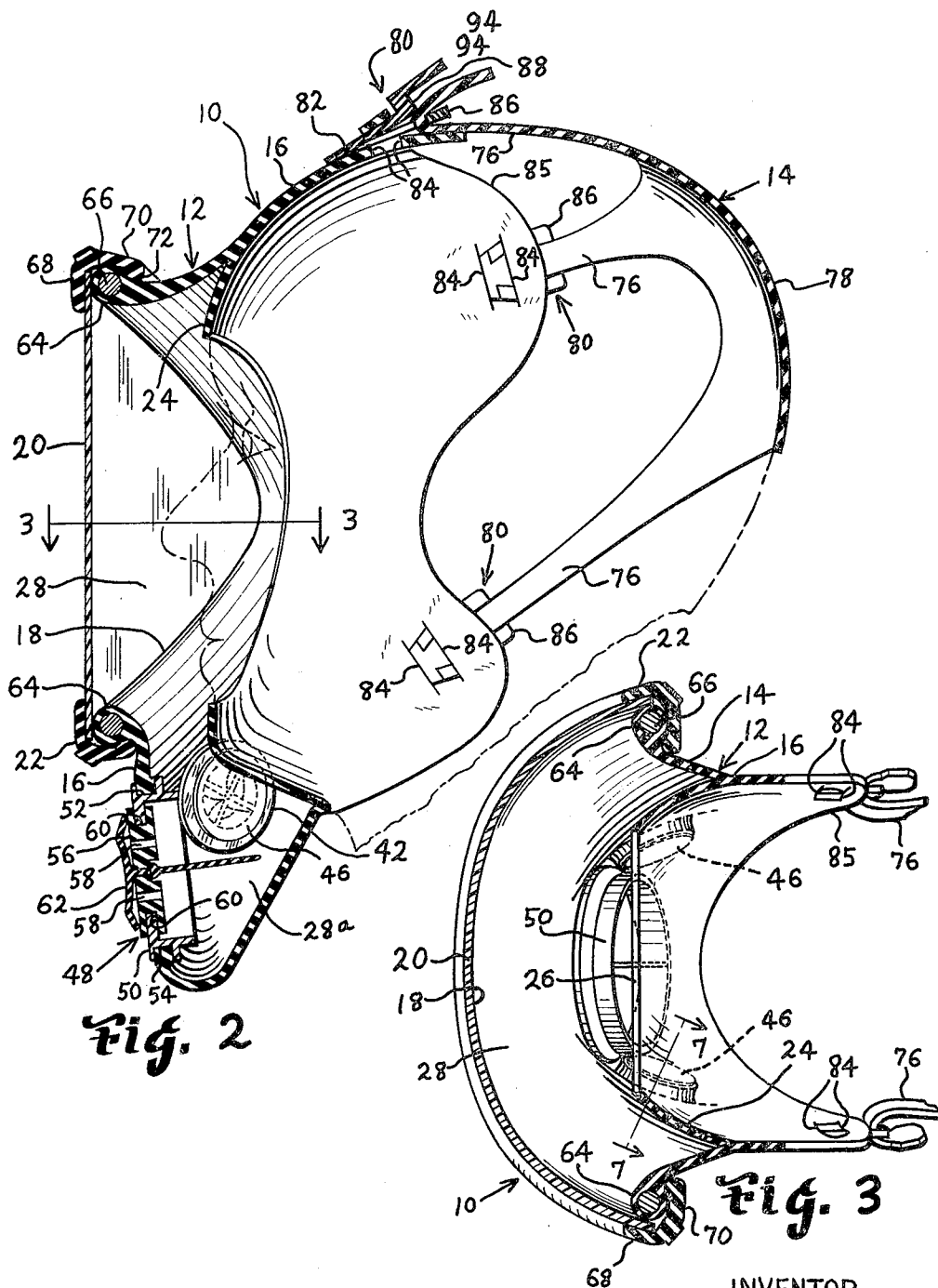


Fig. 2

Fig. 3

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1

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FACE MASKS

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Filed June 14, 1962, Ser. No. 202,544

5 Claims. (Cl. 128-141)

This invention relates to face masks and more particularly to a respiratory mask of the full-face type designed for maximum protection against harmful dusts, fumes, mists, noxious gases or other injurious foreign matters and while not limited to any particular use, the device of the invention is especially suited for protection against radioactive fallout.

In the full-face type of respiratory masks which embody lenses, there is the problem of providing a face fitting seal which offers positive protection against ingress and inhalation of matter injurious to the respiratory system and/or to the eyes or facial tissues and also the problem of providing a similarly effective seal between the lens or lenses and body portion of the mask without unduly complicating the general structure of the mask.

In the field of respiratory protection devices, there is the need for more practical and less expensive face and respiratory protectors which are capable of offering positive protection against radioactivity in atomic fallout, and which are re-usable following exposure to fallout.

While it has been possible heretofore to provide face masks capable of offering what has been considered to be acceptable protection against atomic fallout, their ungainly and complicated nature particularly with relation to the lens holding portions and other fittings has rendered them economically undesirable and impractical if not impossible to clean and sterilize following exposure to radioactive dust or the like.

Conventional face masks of the above character embody various types of fittings such as lens holding clamps, rivets, snaps, hinged buckles and other forms of exposed hardware and parts having crevices and areas into which radioactive dust becomes lodged following exposure to fallout.

In view of the fact that it is impractical and usually impossible to completely clean and remove all radioactive material from conventional face masks, it has been the practice heretofore to use the masks only once and to dispose of them immediately after use. This not only incurs the tremendous expense of continual replacement of face protective equipment in atomic test areas but involves the difficult and costly problem of disposal wherein the articles must be placed in radiation-proof containers and properly buried underground or in the sea.

A primary object of the present invention is to provide a face mask which offers maximum facial and respiratory protection in contaminated atmospheres while at the same time being uniquely simple and economical to manufacture.

Another object is to provide a face mask of the above character embodying a minimum of parts which are so constructed and arranged as to be easily assembled and disassembled with all areas thereof accessible for thorough cleaning so as to be re-usable following exposure to contaminants even of the extremely dangerous type such as atomic fallout.

Another object is to provide, in particular, novel lens supporting and holding means for a respiratory mask of the above full-face type.

Another object is to provide an improved one-piece harness member for supporting the face protective portion of a mask of the above character, said harness member

2

being adjustably connected to said face portion for fitting purposes and readily removable therefrom for cleaning purposes.

A still further object is to provide simple and inexpensive means for adjustably connecting said harness member to said face protective portion of said mask wherein said connecting means, when removed from said mask, will have all portions thereof readily accessible for thorough cleaning.

Another object is to provide a protective mask of the above character which is lightweight, comfortable in use and which provides an exceptionally wide field of unobstructed vision.

Other objects and advantages of the invention will become apparent from the following description when taken in conjunction with the accompanying drawings in which:

FIG. 1 is a partially exploded-perspective view of the device embodying the invention;

FIG. 2 is a vertical cross-sectional view of the device shown completely assembled and in a position of use;

FIG. 3 is a transverse cross-sectional view taken approximately along line 3-3 in FIG. 2 looking in the direction indicated by the arrows;

FIG. 4 is an enlarged cross-sectional view taken on line 4-4 in FIG. 1 looking in the direction indicated by the arrows;

FIG. 5 is a perspective view of a buckle member used in the construction of the device of the invention;

FIG. 6 is a cross-sectional view taken along line 6-6 in FIG. 5; and

FIG. 7 is a fragmentary cross-sectional view taken approximately along line 7-7 in FIG. 3.

Referring more particularly to the drawings wherein like characters of reference designate like parts throughout the several views, it can be seen that the device of the invention comprises a full-face or nasal-oral type of respiratory mask 10 embodying a facepiece 12 and a head harness 14 detachably connected to the facepiece 12 for supporting the same in a position of use.

The facepiece 12 embodies a main body portion 16 having a large forwardly disposed longitudinally curved ocular opening 18 over which an oval shaped lens 20 is placed and secured to the main body part 16 with an elastic lens retainer 22.

The facepiece 12, head harness 14 and lens retainer 22 are each formed of molded rubber or a similar composition preferably of a type such as synthetic nitrile rubber which is highly flexible and elastic when in thin sections, resistant to solvent attack and oxidation and impermeable. The facepiece 12, head harness 14, and lens retainer 22 are all devoid of seams and are each molded with smooth inner and outer surface textures which may be easily cleaned and/or sterilized after use in a manner which will be described in detail hereinafter.

Internally of the facepiece 12 and disposed rearwardly of the lens opening 18, there is provided an inwardly directed thin sectioned flexible and elastic face fitting flange 24 into which the forehead, chin and side portions of a wearer's head are fitted. The flange 24 is formed integral with the main body portion 16 and is provided with an opening 26 which exposes the eyes, nose and mouth of the wearer (see FIG. 2) to a respiratory chamber 28 between the lens 20 and face of a wearer.

Depending from the chin receiving portion of the inner flange 24 is a lower portion 28a of the respiratory chamber 28 which is enclosed by relatively rigid wall parts carrying inhalation and exhalation valve members arranged to permit filtered air to be drawn into the chamber 28 and expelled therefrom.

The walls of the facepiece 12 which surround and form the upper and lower portions of the respiratory chamber

28 are of such thickness and rigidity and are so contoured as to be shape-retaining and non-collapsible when the mask 10 is in use.

In each of the opposite side walls of the lower portion 28a of the respiratory chamber 28 there is provided an opening 30 having a flanged edge 31 (see FIG. 7) into which a filter cartridge adapter 32 is fitted. The cartridge adaptors 32 are each preferably formed of a rigid non-corrosive plastic material or the like such as nylon or polypropylene and have a circular main body which is internally threaded at 34 (see FIG. 7) to receive conventional filter cartridges 36. The cartridges 36 are each threaded into their respective adaptors against an annular gasket 38 which serves to prevent ingress of external atmosphere between the adjoining threaded portions of the cartridges and adaptors. Additionally, the gaskets 38 function to provide spacings 40 between the internal sides of the cartridges 36 and the respective adjacent inner sides of the adaptors 32 thereby permitting a free flow of air from front-to-back through all open portions of the filter cartridges into the spacings 40.

The cartridge adaptors 32 are also each provided with an externally channelled protruding portion 42 which is inserted and detachably snapped into its respective opening 30 and over the flanged edge 31 thereof internally of the respiratory chamber 28 for securement of the adaptors 32 to the body portion 16 of the mask (see FIG. 7).

The portions 42 of the adaptors 32 are provided with openings 44 to allow passage of air from the spacings 40 into the respiratory chamber 28 of the mask 10. Since it is undesirable to exhaust air through the filter cartridges 36, an inhalation valve in the form of a relatively thin and flexible diaphragm 46 formed of rubber or the like is provided to overlie and cover the openings 44 internally of the mask 10 (see FIGS. 2, 3 and 7). In this manner of construction, it can be seen that upon inhalation, the diaphragms 46 will open inwardly allowing air to be drawn through the respective cartridges 36 into the respiratory chamber 28. Upon exhalation, the diaphragms 46 will automatically be forced to close and prevent exhalation through the filter cartridges 36. As mentioned above, it is generally undesirable to draw air through a filter cartridge in more than one direction since this tends to introduce moisture into the cartridge and also continually dislodge particulate matter which has been gathered by the filter material in the cartridge and is adverse to the maximum effectiveness of the filter material.

Since exhalation cannot take place through the filter cartridges 36 in the present construction, an exhalation valve 48 is provided in the forward wall of the lower portion 28a of the respiratory chamber 28 (see FIGS. 1, 2 and 3).

The exhalation valve comprises an annular adaptor section 50 formed of a non-corrosive rigid plastic material or the like which has an outer channel 52 arranged to be detachably snapped into an opening 54 in the main body portion 16 of the mask. The opening 54 has a thickened annular edge arranged to fit tightly within the channel 52 and provide a leak-proof connection therewith.

A grommet-like valve body 56 having exhalation openings 58 therethrough and an outer channelled portion 60 is detachably snapped into the adaptor section 50 as shown in FIG. 2 to provide a secure leak-proof peripheral connection therewith. A valve diaphragm 62 similar to the diaphragms 46 is provided upon the external side of the valve body 56. The diaphragm 62 functions to open outwardly upon exhalation and allows air to be expelled from the respiratory chamber. Upon inhalation, however, the diaphragm immediately closes tightly against the valve body 56 to seal the openings 58 and prevent contaminants from entering the respiratory chamber 28.

It is pointed out that should it be desired to adapt the mask 10 to self-contained breathing apparatus, the valve 48 may be simply replaced by an air line from a com-

pressed air tank or the like and the cartridge adaptors 32 replaced by exhalation valves similar to the exhalation valve 48. It should be understood that various types of conventional inhalation and/or exhalation valves or air or oxygen supply systems may be adapted to the mask 10 to prevent external contaminants from entering the chamber 28 during inhalation and exhalation.

It is further pointed out that the filter cartridges 36 have been shown without details of their internal structures since such cartridges are conventional and commercially available with different filter mediums specifically prepared and arranged therein in accordance with set standards for different purposes. That is, different filter cartridges are commercially available for use in atmospheres containing dust contaminants, noxious gases or chemical fumes and, presently, cartridge type filters are available for use in atmospheres contaminated by radioactive fallout.

Referring more particularly to the eyepiece structure of the mask 10, it will be seen in FIGS. 1, 2 and 3 that the ocular opening 18 is formed with an enlarged bead 64 therearound against which the lens 18 is held by the retainer 22.

The bead 64 is reinforced internally by a rod member 66 which is molded into the material of the body portion 16 so as to be completely sealed against contaminants to which the mask 10 might be subjected. The rod member 66 is preferably formed of aluminum or steel or a similar relatively rigid shape-retaining material and forms a closed loop internally of the molded facepiece 12.

The oval-shaped lens 20 which is formed of a plastic sheet material such as acrylic or polyester resins is secured tangentially against the outer side of the bead 64 and accordingly assumes the generally cylindrically curved shape illustrated in FIG. 3.

The lens retainer 22 is initially molded to a circular configuration such as is illustrated in FIGS. 1 and 4 and is provided with a forward side 68 which is placed against the forward peripheral margin of the lens 20 when the retainer is stretched to such an oval configuration as to fit over the edge of the lens 20 and the bead 64 as illustrated in FIGS. 2 and 3. The rearwardly disposed side 70 of the lens retainer 22 extends over the bead 64 as shown in FIGS. 2 and 3 and is provided with a lip 72 which seats snugly around the rear area of the bead to clamp the retainer 22 and lens 20 securely upon the bead 64.

It can be seen from the drawings that the retainer 22 which is molded to a circular shape is initially of a peripheral dimension considerably less than that of the peripheral dimension of the lens 20 and bead 64. Thus, when the retainer 22 is altered to assume the larger oval configuration of the lens 20 and bead 64, its elastic nature will cause it to seek its relaxed position of smaller size and grip the lens 20 and bead 64 to produce a tight-fitting clamping effect and thereby seal the lens to the body portion 16 of the mask.

The bead 64, being rigidly reinforced by the rod 66 internally thereof will prevent buckling of the lens 20 or distortion of the facepiece 12 under the tension produced by the stretched retainer 22.

As an added precaution against any possibility of contaminants finding their way through the above-described lens connection, a cement or the like (not shown) may be between the forward side 68 of the retainer 22 and the lens 20 if desired. The cement selected for this purpose should, however, be of such character as to peel away or be readily releasable and removable from the respective areas of the lens 20 and retainer 22 which are joined thereby when it is desired to disassemble the various parts of the mask 10 for cleaning purposes.

As it can be seen throughout the drawings, the portions of the facepiece which extend rearwardly from the face fitting flange 24 are relatively thin in cross-section and accordingly are relatively elastic so as to fit snugly

against the head while the flange 24 further elastically engages and tightly fits about the face thereby providing a positive head and face fitting protective seal against ingress of contaminants.

The head harness 14 is formed of a single molded piece of synthetic nitrile rubber or the like having a plurality of strap-like parts 76 extending forwardly from its main body section 78. The body section 78 fits against the rear of a wearer's head substantially as shown in FIG. 2.

In attaching the head harness 14 to the facepiece 12 of the mask 10, a molded or cast plastic buckle 80 is provided upon the end of each strap-like part 76 thereof. The buckles 80 are each preferably formed of a rigid but resilient non-corrosive plastic such as a polycarbonate resin. As shown in FIGS. 1, 5 and 2, each buckle 80 embodies a forwardly disposed arrowhead-type of end section 82 which is inserted through receiving slots 84 provided adjacent the rear edge 86 of the body portion 16 of the facepiece 12. The barbed configuration of the sections 82 prevents withdrawal of the buckles from the slots 84 and provides a secure connection with the facepiece 12. By stretching the material between the slots 84, however, the buckles can be readily removed when desired.

Extending rearwardly from the end section 82 of each buckle 80 and depending somewhat therefrom is a looped section 86 (see FIGS. 2, 5 and 6) through which a strap part 76 of the head harness is drawn and reversed upon itself as shown in FIG. 2. In adjustably clamping the strap part 76 at a desired adjusted position in the buckle 80, an upper portion 88 of the buckle is arranged to bind the strap part 76 against the looped section 86. In order to perform this function, the upper portion 88 is integrally connected to the looped section 86 by a relatively narrow section 90 of the molded plastic which is reinforced by a rib 92.

The buckles 80 are molded with the upper portion 88 substantially level with the upper surface of the looped section 86 as shown in FIGS. 5 and 6 so that when these two sections are forcibly separated by insertion of a strap part 76 as shown in FIG. 2, their tendency to return to their relaxed positions causes the strap part 76 to be pinched therebetween and prevented from pulling rearwardly out of the buckle. A finger grip 94 is provided on each buckle 80 by means of which the upper portions 88 may be lifted away from their respective looped sections for ease of insertion and adjustment of strap members 76 disposed therebetween.

It can be seen in FIGS. 5 and 6 that the buckles 80 are so connected as to have all surface areas thereof exposed and readily accessible for cleaning and sterilization when removed from the mask 10. That is, there are no overlying portions or cracks and crevices which cannot be thoroughly cleaned.

As mentioned above, all components of the structure of this invention are so designed and constructed as to be free of inaccessible crevices or the like.

Following use in highly contaminated areas, the mask 10 is disassembled for cleaning purposes by removing the head harness buckles 80, the lens retainer 22 and lens 20, the exhalation valve 48 and the filter cartridge adaptors 32.

The filter cartridges are removed from the adaptors 32 and disposed of and the subassemblies of the exhalation valve and adaptors are further disassembled by removal of their respective diaphragms and other separable parts. All components of the mask 10, with the exception of the filter cartridges which are discarded and subsequently replaced, are then placed in a suitable solvent or bath to be cleaned and/or sterilized for re-use.

From the foregoing, it can be seen that simple, inexpensive and reliable means has been provided for accomplishing all of the objects and advantages of the invention. It is to be understood, however, that various

changes in the details of construction and arrangement of parts may be made without departing from the spirit of the invention as expressed in the accompanying claims and the invention is not limited to the exact matters shown and described as only preferred matters have been given by way of illustration.

Having described my invention, I claim:

1. A face mask of the character described comprising a facepiece embodying a flexible main body portion having an ocular opening therein, a continuous tubular bead extending marginally about said ocular opening, reinforcing means consisting of a rod element of rigid shape retaining material formed in a closed loop configuration internally of said tubular bead to retain the shape characteristics desired of said ocular opening, a lens having a contour substantially corresponding to that of said opening and being of such size as to overlie said opening and the major portion of said bead when centered over said ocular opening, said lens being approximately centered relative to said ocular opening with the marginal portion of one side thereof seated against said bead in substantially continuous line contact with one side thereof, an annular elastic retaining member having a forward portion disposed against the marginal portion of the side of said lens opposite to said one side thereof and having an integral rearwardly disposed portion overlying the edge of said lens and at least a portion of said bead, said retaining member being under elastic tension against the forward side of said lens and rearwardly biasing said lens against said bead, said facepiece being so contoured rearwardly of said ocular opening and of such character as to elastically fit and provide a hermetic seal about the chin, forehead and sides of the face when said mask is in use with the face disposed in rearwardly spaced relation to said lens and ocular opening to provide a respiratory chamber between said lens and the face and air inlet and outlet means communicating with said chamber through said body portion.

2. A face mask of the character described comprising a facepiece embodying a flexible main body portion having an oval-shaped ocular opening, a continuous tubular bead extending marginally about said ocular opening, reinforcing means consisting of a rod element of rigid shape retaining material formed in a closed loop configuration internally of said tubular bead, said reinforcing means being of such rigidity as to cause said bead to retain the shape characteristics desired of said ocular opening, a sheet-like lens member having a contour substantially corresponding to that of said ocular opening and being of such size as to overlie said opening and the major portion of the thickness of said bead when centered relative to said ocular opening, said lens member being disposed with the marginal portion of one side thereof in continuous line contact with said bead outwardly of said facepiece, an annular elastic lens retaining member having a forward portion disposed against the marginal portion of the side of said lens member opposite to said one side thereof and having an integral rearwardly disposed portion overlying at least a portion of said bead and the edge of said lens member, said retaining member being under elastic tension against the forward side of said lens member and rearwardly biasing said lens member against said bead.

3. A face mask of the character described comprising a facepiece embodying a flexible main body portion having an oval-shaped ocular opening curved in the direction of its longest dimension, a continuous tubular bead extending marginally about said ocular opening, reinforcing means consisting of a rod element of rigid shape retaining material formed in a closed loop configuration internally of said tubular bead, said reinforcing means being of such rigidity as to cause said bead to retain the shape characteristics desired of said ocular opening, an oval-shaped sheet-like lens member adapted to overlie said ocular opening, said lens member being disposed with

the marginal portion of one side thereof in substantially continuous line contact with said bead, an elastic lens retaining member characterized to be generally circular in configuration and of a smaller circumferential dimension than that of said bead when said retaining member is in its relaxed condition, said retaining member being expanded to the larger oval peripheral size and configuration of said lens member and bead and placed under elastic tension over said lens member and bead with a forward portion thereof disposed against the forward marginal portion of said lens member and an integral rearwardly disposed portion overlying at least a portion of said bead to rearwardly bias said lens member against said bead, air inlet and outlet means in said facepiece and head harness means for supporting said facepiece in a position of use.

4. A face mask of the character described comprising a facepiece embodying a molded flexible body portion having an oval-shaped ocular opening therein, a continuous tubular bead integral with said facepiece and extending marginally about said ocular opening, reinforcing means consisting of a rod element of rigid shape retaining material formed in a closed loop configuration molded internally of said bead throughout the length thereof and disposed approximately coaxially therein, said reinforcing means being of such rigidity as to cause said bead to retain the shape characteristics desired of said ocular opening, a sheet-like lens having an oval configuration corresponding to that of said ocular opening and a peripheral dimension slightly less than the maximum peripheral dimension of said bead, said lens being of such size as to overlie said ocular opening and the major portion of said bead when centered over said ocular opening and being disposed with the rearward marginal portion thereof in continuous line contact with said bead, an annular elastic lens retaining member having integrally related forward and rear portions, said lens retaining member being generally circular in configuration and of a lesser circumferential dimension than that of said bead when in its relaxed condition, said retaining member being expanded to the larger oval configuration and size of said bead and fitted over said lens and bead under elastic tension with said forward portion thereof disposed against the forward marginal portion of said lens and with its rear portion overlying at least a portion of said bead and the edge of said lens to rearwardly bias said lens against said bead, air inlet and outlet means in said facepiece and harness means for supporting said facepiece in a position of use.

5. A face mask of the character described comprising a facepiece embodying a flexible main body portion hav-

ing an oval-shaped ocular opening curved in the direction of its longest dimension, a continuous tubular bead integral with said body portion extending marginally about said ocular opening, reinforcing means consisting of a rod element of rigid shape retaining material formed in a closed loop configuration internally of said bead, said reinforcing means being of such rigidity as to support said bead and retain the shape characteristics desired of said ocular opening, a sheet-like lens having an oval configuration corresponding to that of said opening and being of such size as to overlie said opening and the major portion of said bead when centered over said opening, said lens being disposed with the marginal portion of one side thereof in substantially continuous line contact with said bead, an annular elastic lens retaining member having forward and rear portions integrally connected together adjacent the outer perimeter of said member and being separable from one another adjacent the inner perimeter thereof, the inner peripheral edge of said rear portion of said lens retaining member having a generally right angularly disposed lip directed toward said forward portion of said member, said lens retaining member as a whole being generally circular in configuration and of a lesser circumferential dimension than that of said bead when said member is in its relaxed condition, said retaining member being expanded to the larger oval configuration and size of said bead and elastically under tension with said forward portion thereof disposed against the marginal portion of the side of said lens opposite to said one side thereof and with said rear portion of said retaining member overlying at least a portion of said bead to rearwardly bias said lens against said bead and said lip being seated under tension in the juncture between said bead and said body portion of said facepiece.

References Cited by the Examiner

UNITED STATES PATENTS

2,375,147	5/1945	Teague	128—141
2,381,047	8/1945	Glekler	24—77
2,465,973	3/1949	Bulbulian	128—141
2,790,222	4/1957	Creedon	24—77
2,952,852	9/1960	Corey	2—14
2,952,853	9/1960	Benzel	2—14
2,996,722	8/1961	Jacobs	2—14

FOREIGN PATENTS

664,691	9/1938	Germany.
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